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VALIDATION OF THE U. S. NAVY FLEET DIVER PHYSICAL SCREENING TEST

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TECHNICAL REVIEW AND APPROVAL

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The experiments reported herein were conducted according to the principles set forth in the current edition of the "Guide for the Care and Use of Laboratory Animals," Institute of Laboratory Animal Resources, National Research Council.

This technical report has been reviewed by the NMRI scientific and public affairs staff and is approved for publication. It is releasable to the National Technical Information Service where it will be available to the general public, including foreign nations.

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The development of job-related selection and training methods will improve safety and lead to substantial cost savings to the Navy through enhanced screening and productivity. The present investigation determined the extent to which the current U.S. Navy fleet diver physical screening test predicted performance of 5 representative physically demanding job tasks.

Subjects were 146 male diver candidates (age 25.1 ± 4.3 yr, $\bar{X}$ ± SD, range 18-37 yr) undergoing training at the Naval Diving Salvage and Training Center, Panama City, FL. Results indicate the current U.S. Navy fleet diver physical screening test provides a poor estimate of representative job task performance for the population of diver candidates tested. A finding of particular operational significance was that a substantial number of diver candidates who passed current physical screening test standards were unable to complete (i.e, failed) the tool-bag swim (18.5%) and fin-kick (25.7%) tasks. Results suggest the current screening test has limited utility for physical selection purposes and underscore the need of developing a requirements-based selection battery to ensure that diver physical capabilities are aligned to the job.

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I. INTRODUCTION

Current entry-level physical screening test standards for U.S. Navy fleet divers are defined in the Naval Military Personnel Manual (1). There is no evidence that these fitness standards are based on job performance requirements. Further, upon graduation from training commands, there is no required minimum level of fitness for fleet divers beyond that required for all U. S. Navy personnel by the Physical Readiness Test (PRT). The PRT is less demanding than the entry-level diver test and is not related to fleet diver job performance.

A job-related physical testing and training program for fleet divers is required for the following reasons:

a. Approximately $1.2 million dollars in training funds was lost from FY-89 through FY-91 at the Naval Diving and Salvage Training Center (NDSTC) because students failed to meet entry-level diver physical screening test requirements.

b. Since the current entry-level physical screening test is not based on job performance requirements, potential challenges of gender discrimination may not be defensible. Female students who cannot meet the minimum requirements may challenge the basis for the requirements.

c. Nearly one hour of every training/work day at most diving commands is allotted for physical conditioning. Identification of job-related requirements can improve the effectiveness of physical training programs.

Using a criterion-related validation strategy, the objective of this investigation was to determine the extent to which the current U.S. Navy fleet diver physical screening test is a determinant of representative diving task performance.

Aligning fleet diver selection and training procedures to the physical demands of the job ensures a high level of operation readiness by enhancing screening, work productivity, and reducing the likelihood of injury and time lost off the job.

II. METHODS

Subjects

One-hundred and forty-six male diver candidates (age 25.1 ± 4.3 yr, $\bar{X}$ ± SD, range 18-37 yr) participated in the study. Diver candidates were participating in first class, second class, diving medical technician, and basic diving officer training at NDSTC. Only subjects who met current entry-level physical screening test standards were tested. Since candidates generally perform to minimum standards on the first physical screening test, scores presented here represent performance on the second screening test which is a maximal effort. Due to schedule conflicts, medical waivers, attrition, etc., a number of individuals who completed the initial body composition assessment, did not complete the second physical screening test and all job tasks.

After procedures were explained in detail, all subjects gave written informed consent. All subjects passed a physical examination to screen for medical conditions that could increase the risk of injury during testing. This study was approved by the Committee for the Protection of Human Subjects at the Naval Medical Research Institute, Bethesda, MD.

U.S. Navy Fleet Diver Physical Screening Test

Minimum standards for the U.S. Navy fleet diver physical screening test are as follows:

Test Item	Requirement
500-yard swim	(14:00 min)
Push-ups	(42 in 2 min)
Sit-ups	(50 in 2 min)
Pull-ups	(6, no time limit)
1.5-mile run	(12:45 min)

Test administration procedures are outlined below:

1. 500-yard swim - The swim was conducted in a 25-meter pool. Diver candidates began the swim in the water and were allowed to push off with their hands and feet after each pool length. Candidates were permitted to use only sidestroke and/or breaststroke. Time to complete the swim was measured to the nearest second. A ten-minute rest period was allowed before the next test was administered.

2. Push-ups - This test was performed with the back straight, head up, and knees together. Candidates lowered themselves to the ground, bending their elbows, keeping their bodies straight, until their chests touched the ground. They then pushed their bodies up, keeping their back straight and locking their elbows. The maximum number of push-ups in two minutes was recorded. A two-minute rest period was allowed before the next test was administered.

3. Sit-ups - This test was performed with the hands clasped behind the head, knees bent at approximately a 120-degree angle, with feet together and held flat against the ground by a partner. Candidates were instructed to raise their upper body to an upright position and attempt to touch their knees to their forehead (left knee and right knee on alternating counts) prior to lowering their upper body to the ground. Maximum number of sit-ups in two minutes was recorded. A two-minute rest period was allowed before the next test was administered.

4. Pull-ups - This test was performed by grasping the pull-up bar and hanging straight down. Hands were placed on the bar with palms facing away from the body, at shoulder width. Candidates were then instructed to pull their chins over the bar. Candidates were not allowed to swing or bicycle their feet as they pulled their chin over the bar and they had to maintain a vertical position during the entire test. The maximum number of pull-ups completed was recorded (no time limit). A ten-minute rest period was allowed before the next test was administered.

5. 1.5-mile run - The run was conducted on a level road. Candidates were dressed in shorts and sneakers. Completion time was measured to the nearest second.

Job Performance Assessment Battery

Job performance assessment battery development was based on survey and interview data provided by U.S. Navy fleet divers, objective work-site measurements collected at NDSTC, and an extensive review of videotape data (2). The final selection process took into consideration potential testing problems that might be encountered in a field setting such as

extensive use of operational equipment, time-consuming test procedures, the need for a large test administration staff, and safety issues. The representative tasks included in the job performance assessment battery are described on the following pages.

FIGURE 1. Divers swim while carrying tool bags.

(1) Tool-Bag Swim - SCUBA diver (wearing twin 80s, breathing air) swims a distance of 200 ft while carrying a 24-lb tool bag (Fig. 1).

This task was conducted in the NDSTC swimming pool. A dive team and safety diver were present during all testing. Subjects wore twin 80 SCUBA and breathed air. Subjects started the task in the water along one side of the pool. They were instructed to swim across the width of the pool (a distance of 50 ft) and then return. This was repeated again so that a total distance of 200 ft was covered. Subjects carried the tool bag on one arm and were allowed to rest, if necessary, along the side of the pool. Performance was scored as pass/fail (i.e., subjects who passed were able to swim the entire distance without contacting the bottom).

FIGURE 2. SCUBA diver attempts to stay on the surface by fin-kicking.

(2) Fin-Kick - SCUBA diver (wearing twin 80s, breathing air) attempts to remain on surface by fin-kicking (Fig. 2).

This task was conducted in the NDSTC pool. A dive team and safety diver were present at all times during testing. This task was modelled after the current water survival test conducted at NDSTC. Subjects wore twin 80s, but did not breathe from the regulator. The task was started in the water and subjects were instructed to remain afloat by fin-kicking. They were required to raise their arms up and keep their hands out of the water. Performance was scored as pass/fail (i.e., subjects who passed were able to stay on the surface for a period of 5 min).

FIGURE 3. MK-21 diver descends/ascends a vertical ladder.

(3) Ladder Climb - MK-21 diver (fully weighted, single SCUBA, breathing air) descends/ascends a 14-ft vertical ladder (Fig. 3).

This task was conducted in the NDSTC open tank. The tank was not filled with water during the testing period. Subjects were dressed in MK-21 gear, breathing air (helmet, 28 lbs; boots, 12 lbs; IDV and weights, 38 lbs; single SCUBA, 32 lbs). Subjects were instructed to climb down the ladder until both feet were on the bottom of the tank and then ascend the ladder as quickly as possible. The task started with subjects standing on the tank deck and ended when the subjects returned to that position. Tenders controlled the umbilical line to ensure safety. Performance was scored as the total time (min) required to descend/ascend the ladder.

FIGURE 4. Diver lifts/carries twin 80 SCUBA bottles.

(4) SCUBA-Bottle Carry - Diver lifts/carries twin 80 SCUBA bottles a distance of 450 ft (including up/down ship's ladder) (Fig.4). This task was conducted on the pier and NDSTC training craft. Prior to testing, the task was demonstrated using proper lifting technique. Subjects were instructed to do the following:

(1) Lift the twin 80 SCUBA bottles from the pier.
(2) Carry the SCUBA bottles onto the training craft, down an inclined ladder, and set them down in a dive locker (a distance of 75 ft).
(3) Lift the SCUBA bottles and carry them back up the ladder to the starting point. Set the SCUBA bottles down on the pier.
(4) Repeat this task 3 times.

Subjects were advised to walk as fast as possible throughout the entire course, but not to run. Subjects were instructed to carry the twin 80 SCUBA bottles horizontal to the deck in front of their bodies. Subjects were allowed to walk through the course for practice. Monitors were positioned by the ladder to ensure safety. Performance was measured as the total time (min) required to complete the task.

FIGURE 5. Topside diver pulls an umbilical line.

(5) Umbilical Pull - Topside diver pulls an umbilical line (weighted to 100 lbs) a distance of 50 ft (Fig. 5).

This task was conducted in the ascent tower. Prior to testing, the task was described and demonstrated. Divers were instructed to pull an umbilical line (weighted to 100 lbs) a distance of 50 ft. Subjects were allowed to pull the weight a short distance off the bottom for practice. Performance was scored as total time (min) required to pull the weight to the surface.

Statistical Analysis

Descriptive statistics including means, standard deviations, and ranges were determined to describe diver physical characteristics (i.e., age, height, etc), and provide physical screening test and job performance assessment battery data.

Comparison of physical screening test scores for diver candidates who passed/failed the in-water job tasks (i.e., fin-kick and tool-bag swim) was assessed using paired t-tests.

Multiple regression techniques were employed to develop regression equations for

predicting shipboard job tasks (i.e., climb ladder, lift/carry SCUBA bottles, and pull umbilical line) from physical screening test scores. Fitness measures entered the equation in a forward step-wise fashion. Minimum tolerance was set at 0.15 for variables entering the equation.

III. RESULTS

Descriptive statistics of the diver candidates are found in Table 1.

Table 1. Descriptive Statistics of Diver Candidates (N=146)*

VARIABLE	MEAN	S.D.	RANGE
Age (yrs)	25.1	± 4.3	18.0-37.0
Height (in)	69.3	± 2.4	63.5-77.0
Weight (lbs)	170.5	± 17.9	130.0-216.5
Fat Weight (lbs)	22.3	± 8.1	5.9-42.6
% Fat	12.8	± 3.7	4.0-23.0
Lean Body Weight (lbs)	148.4	± 13.1	108.8-189.2

* N=145 (Fat Weight, % Fat and LBW)

The percentage body fat of diver candidates was found to be somewhat lower (12.8, ± 3.7, $\bar{X}$ ± SD) than values reported for Navy recruits (14.5, ± 4.2, $\bar{X}$ ± SD), auxiliary ship personnel (16.4, ± 5.3, $\bar{X}$ ± SD), or submarine personnel (16.1, ± 5.5, $\bar{X}$ ± SD) (3).

Physical screening test and job performance assessment battery scores are provided in Tables 2 and 3, respectively. Because of differences in test procedures and the sequence of test administration, a comparison of physical screening test data with other calisthenic/aerobic tests involving Navy populations was not made.

Table 2. Physical Screening Test Scores of Diver Candidates (N=136)*

VARIABLE	MEAN	S.D.	RANGE
500-yd Swim (min)	10.3	± 1.0	7.9-12.6
Sit-Ups (#)	70.0	±12.8	50.0-110.0
Push-Ups (#)	61.4	±11.8	42.0-99.0
Pull-Ups (#)	11.5	± 3.3	6.0-24.0
1.5-Mile Run (min)	10.2	± 0.8	7.8-12.2

*N=135 (Swim, Run)

Table 3. Job Performance Assessment Battery Scores of Diver Candidates				
VARIABLE	N	MEAN	S.D.	RANGE
Swim/Carry Tool Bag (min)	70	2.2	± 0.8	1.3-4.4
Fin-Kick (min)	71	4.7	± 0.6	2.7-5.0
Climb Ladder (min)	88	0.4	± 0.1	0.2-0.7
Lift/Carry SCUBA Bottle (min)	125	4.6	± 1.0	2.7-7.1
Pull Umbilical (min)	118	0.7	± 0.2	0.3-1.6

A scatterplot of physical screening test scores vs. job tasks is provided in Figure 6. This figure helps to graphically illustrate the poor relationship observed between physical screening test scores and job task performance.

Fin-kick performance was scored as pass/fail and treated as a dichotomous variable (diver candidates who passed the test were able to remain on the surface for a period of 5 min). The tool-bag swim task was also scored as pass/fail. Subjects who did not complete

the tool-bag swim (i.e., failed) did not receive a time. Therefore, the scores of subjects failing the tool-bag swim are not presented in this scatterplot.

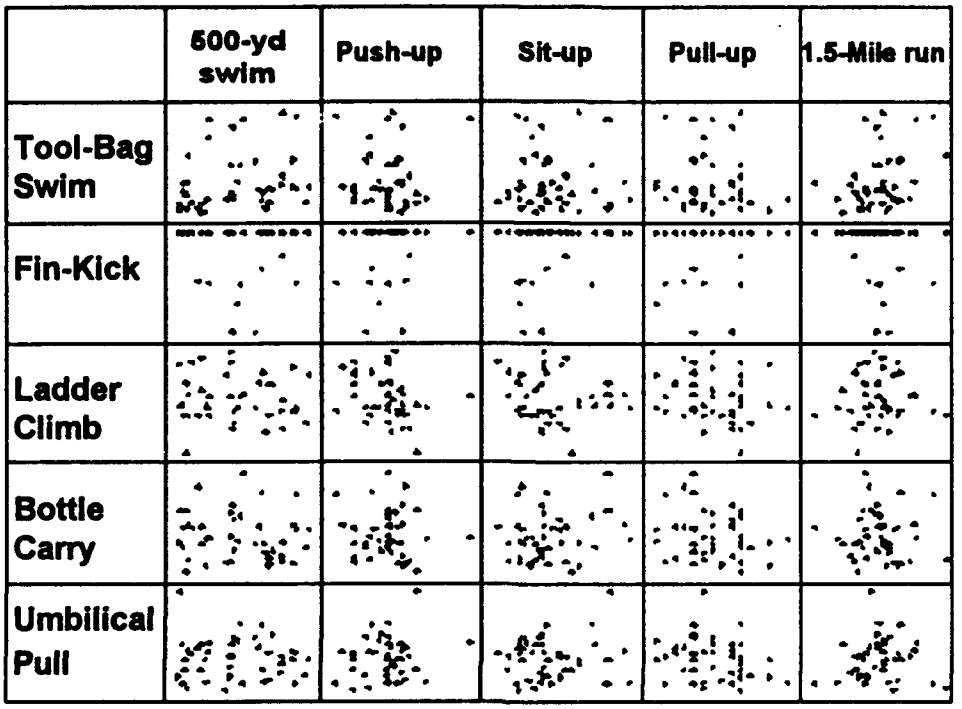

FIG 6. Scatterplot of Screening Test vs. Tasks

A comparison of physical screening test scores for candidates who passed/failed the two in-water tasks can be found in Tables 4 and 5. Results show physical screening test scores of candidates passing the in-water tasks were significantly higher than those of task failures in only one instance (push-up for the fin-kick task, $P < 0.05$, Table 5).

A finding of particular operational significance was that a substantial number of diver candidates who passed current physical screening test standards were unable to complete (i.e., failed) the tool-bag swim (18.5%, Table 4) and fin-kick (25.7%, Table 5) tasks. All divers were able to complete the three shipboard tasks.

Table 4. Comparison of Physical Screening Test Scores For Candidates Passing/Failing Tool-Bag Swim Task

	PASS GROUP (N=53) *		FAIL GROUP (N=12)		
	MEAN	S.D.	MEAN	S.D.	T
500-yd Swim	10.0	± 1.0	10.4	±1.2	1.2
Push-Ups	63.0	±10.1	61.2	±15.3	-0.5
Sit-Ups	74.7	±4.1	72.7	±16.0	-0.4
Pull-Ups	11.8	±3.1	12.0	±4.3	0.1
1.5-Mile Run	9.8	± 0.7	10.2	±0.8	1.6

None of the group differences was significant
T= Pooled Variances T
* N= 52 (500-yd Swim), 51 (1.5-mile run)

Table 5. Comparison of Physical Screening Test Scores For Candidates Passing/Failing Fin-Kick Task					
	PASS GROUP (N=49)**		FAIL GROUP (N=17)		
	MEAN	S.D.	MEAN	S.D.	T
500-yd Swim	10.0	±1.1	10.3	±1.0	-1.1
Push-Ups	64.8	±11.7	57.9	±8.0	2.2*
Sit-Ups	76.3	±14.4	68.9	±12.0	1.9
Pull-Ups	12.2	±3.3	10.6	±3.0	1.7
1.5-Mile Run	9.8	±0.8	10.2	±0.6	-1.6

*Significant Group Difference (P< 0.05 level)
T= Pooled Variances T
**N=48 (500-yd Swim, 1.5-Mile Run)

Results of regression analyses between the physical screening test and shipboard tasks are reported in Table 6. Findings show physical screening test scores are not predictive of representative shipboard tasks.

Table 6. Prediction of Shipboard Tasks from Physical Screening Test Scores

JOB TASKS	PREDICTORS	MULT R	RSQ CHANGE	B*	S.E.E.**
Climb Ladder	No Significant Predictors				
Lift/Carry SCUBA Bottle	"				
Pull Umbilical Line	"				

* B is regression coefficient
** S.E.E.= standard error of estimate
N=88 (Ladder), 125 (Bottle), 118 (Umbilical)

IV. DISCUSSION

The major finding of this investigation was that the current entry-level U. S. Navy fleet diver physical screening test provides a poor estimate of physically demanding in-water and shipboard job tasks representative of diver's work. This finding is graphically illustrated in Figure 6.

Lack of a strong relationship between the physical screening test and diver job performance may be due to a lack of test specificity (i.e., the test does not reflect the efforts, muscle groups, and postures involved in performance of the task). For example, the in-water tasks evaluated during this investigation involved swimming with a heavy tool bag and attempting to remain on the surface by fin-kicking. Both of these tasks were performed in

SCUBA gear and fins.

The component of the physical screening test used to measure diver proficiency in the water is the 500-yd swim. This test is very different from the diving tasks. It requires diver candidates to swim the prescribed distance within 14 min using the breast and/or side stroke. Tools or equipment are not required to be carried. SCUBA gear is not worn and use of fins is not authorized.

It should also be pointed out that 500-yard swim time is poorly correlated with maximum oxygen consumption and related more to swimming technique (4). Such findings suggest that, in addition to not being related to in-water task performance, the 500-yard swim test has limited value as a measure of aerobic fitness.

Lack of test specificity may also explain the poor relationship observed between physical screening test scores and shipboard task performance. There are few, if any, diving tasks that resemble the movements used during these exercises. In the fleet, divers frequently lift, carry, push, and pull heavy objects (e.g., materials, equipment, and tools). High muscular strength demands are often placed on muscles groups of the arms, legs, and back. Job task performance measured during this study, such as lifting/carrying twin 80 SCUBA bottles or pulling a umbilical line (weighted to 100 lbs), characterize these types of efforts. The diver physical screening test does not contain a test that measures ability to move external objects. Sit-ups, push-ups, and pull-ups measure ability to move one's own body weight and involve body efforts that are quite different from those required for lifting and carrying external objects.

If a closer relationship existed between the physical test and the job task, increased specificity and greater validity could be achieved. For entry-level screening purposes, perhaps a traditional strength test (i.e., shoulder press, leg press, etc.) that involves lifting a weight external to the body would more closely reflect diving-related task demands. Assessment of lean body weight may also be a valid screening test measure. Lean body weight has been found to provide a good estimate of a variety of shipboard tasks involving lifting and carrying efforts (5,6).

While current physical screening test standards appear unrelated to diver job performance, it may be a useful screening mechanism for entry into physical training. Arguably, the physical training experienced during fleet diver training is more demanding than job tasks that are required to be performed. The current physical training program consists of daily bouts of intense calisthenic exercises (i.e., sit-ups, push-ups, pull-ups, etc.) and aerobic training (group runs, bay swims, etc). Current standards may help to identify those candidates not physically prepared to participate in a rigorous physical training curriculum.

An ancillary finding of particular operational significance was that a substantial number of candidates who passed current physical screening test standards, failed (i.e., were unable to complete) the in-water job tasks. These results support findings discussed previously that fitness attributes measured by the physical screening test are poorly associated with job performance. It also suggests that a greater emphasis should be placed on job-related, in-water training.

It is believed a major strength of this study was that it was conducted in a field setting. A significant limitation in this line of research has been oversimplification of the task. Taking a real world task and reducing it to it's most basic components in a laboratory often ignores the complexity of the task. Such studies are obviously of quite limited application to fleet diving scenarios.

A limitation of this study was that only subjects who met current physical screening test standards were tested. Therefore, the sample population may represent a somewhat more fit group than experienced at entry-level. It is not known to what extent including individuals who had not met initial physical screening test standards would have on study results.

In summary, the underlying problem in the development of job-related standards for divers is the complexity of the job. Tasks are performed both in-water and onboard ship. A wide variety of basic body efforts are routinely performed (i.e., lifting, lifting/carrying, pushing/pulling, swimming/carrying, etc.). Tasks involve both dynamic and static movements. Task completion may require maximal or submaximal efforts. The Navy has relied on simple field measures of physical fitness for screening purposes because they were reliable, easy to administer, and were believed to be valid predictors of job performance. It is evident from the findings of this investigation that a more task-oriented physical screening test needs to be developed. Therefore, future work will focus on the development of a task-oriented fitness battery from which the most reliable, sensitive, and predictive measures of job performance will be selected for screening purposes.

V. CONCLUSIONS

1. The use of realistic diving tasks conducted in a field setting appears to be a valid approach for measuring diver job performance.

2. Current physical screening test criteria do not accurately reflect the physical demands of the job.

3. Validation of a task-oriented experimental fitness battery may provide the basis for establishing improved physical selection criteria for the U.S. Navy Fleet Diving Program.

REFERENCES

1. Naval Military Personnel Manual MILPERSMAN 1410380 and 1410400, Washington, DC.

2. Marcinik, E.J., Schibly, B.A., Hyde, D. and T.J. Doubt, An Analysis of Physically Demanding Tasks Performed by U.S. Navy Fleet Divers, NMRI Technical Report No. 93-15, Naval Medical Research Institute, Bethesda, MD, 1993.

3. Hodgdon, J.A. and E.J. Marcinik, A Survey of Body Fat Content of U. S. Navy Male Personnel, NHRC Report No. 83-4, Naval Health Research Center, San Diego, CA, 1983.

4. Buono, M.J., Validity of the 500 Yard Swim and 5 Kilometer Stationary Cycle Ride as Indicators of Aerobic Fitness. NHRC Report No. 87-27, Naval Health Research Center, San Diego, CA, 1987.

5. Beckett, M.B. and J.A. Hodgdon, Lifting and Carrying Capacities Relative to Physical Fitness Measures, NHRC Report No. 87-26, Naval Health Research Center, San Diego, CA, 1987.

6. Robertson, D.W. and T.T. Trent, Documentation of Muscularly Demanding Job Tasks and Validation of an Occupational Strength Test Battery (STB), NPRDC Report No. 86-1, Navy Personnel Research and Development Center, San Diego, CA, 1986.